of October, during the passage of an extensive depression on the west side of the Danish Islands and moving to the northwest. The wind from west-northwest that blew at Frederiksted from 10 to 1 that night and did some damage to the small craft there, was probably a part of that minor movement.

The details given in Captain Dix's notes are very interesting and they show that the stormy weather struck the several islands from St. Kitts to Dominica *about the same time*. If we run a line out from the assumed position of the cyclone's center on Tuesday night at right angles to its track and going south-southeast, we shall find that it passed west of the islands, which will lie, roughly speaking, parallel to it. It seems that the whole southeast quadrant of the cyclone was stormy, but was most so in the neighborhood of that line, on the passing of which all of the islands affected were, in fact, at about their nearest to the center. After that had passed and the southwest quadrant was entered, the wind, though maintaining its cyclonic movement, fell to mild westerly breezes. Why it did so is an interesting speculation, but here we only note the fact. Later on information from the different islands may throw further light on the whole subject, but we think that, in the main, the theory given above in our article will be sustained.

POPULAR ARTICLES REQUESTED.

It is doubtless known to many of our readers that the beautiful magazine, St. Nicholas for Young Folks, has for several years devoted a few pages to a department of nature and science, in which occasionally we find something bearing on the weather or the atmosphere. The editor has recently appealed to us for further contributions "on some weather phenomenon of instruction and entertainment to young folks." A similar request has also been received from the editor of the Youths' Companion. We believe we can not do better for the general cause of meteorology than to urge that those who are gifted in writing such sprightly articles as are acceptable to these magazines send their efforts to the St. Nicholas Magazine, Century Company, Union Square, New York City, or to The Youths' Companion, Boston, Mass., so as to make sure that meteorology and its interesting atmospheric phenomena are brought home to the attention of their readers.

BLACK RAIN IN CLERMONT COUNTY, OHIO, AUGUST 19, 1903.

Mr. J. Warren Smith, Section Director, Columbus, Ohio, has forwarded some samples of black rain, collected by Dr. Julius D. Abbott, of Bethel, Ohio, which fell on August 19, 1903, and was the third black rain that had occurred this year. Dr. Abbott says that the creeks and even the furrows in the fields were full of this black water, but the sample that he sends the Weather Bureau was taken out of a perfectly clean porcelain kettle. He states that the black coloring substance does not settle but gives the water a permanent inky appearance. It leaves a black scum on the creek banks and on the grass. A similar description of the rain was received from Daniel Bohl, at Laurel, Clermont County, Ohio.

Samples of the dust from black rains have often been examined microscopically and chemically. An elaborate report of this kind will be found in the MONTHLY WEATHER REVIEW for January, 1895. It seemed likely that a physical examination of the dust and a determination of the size of the particles would be especially interesting in the present case, as Dr. Abbott's sample evidently represented the finest dust of which the great beds of loess are formed. The sample was, therefore, sent to Prof. Milton Whitney, Chief of the Bureau of Soils, who reports as follows:

The material in suspension was found to be completely floculated when the sample was received and would soon settle to the bottom of the vial, even after being violently agitated. The addition of a small amount of ammonia to a part of the sample served to break the floculation, and a microscopic examination of this material showed that it was, for the most part, exceedingly fine, many of the particles being less than one-thousandth of a millimeter in diameter. There were, however, a few transparent crystalline particles which were probably quartz. The vial when first opened emitted a strong odor of hydrogen sulphide. This fact, together with the microscopic examination, leads me to believe that the material is probably extremely fine soil with a considerable portion of organic matter, as Mr. Smith has suggested.

The explanation offered by Mr. Smith is as follows:

These two places are in southern Clermont County, east of a long bend in the Ohio River. I shall be glad to know whether my theory that this "black rain" is the dust blown up in the outrushing squall in advance of the thunderstorm is considered a satisfactory one. The Ohio River must be low at this point and the long drought must have dried the black mud deposit on the river banks into dust so that it would be easily blown high into the air, to be deposited 15 or 20 miles to the east."

We see no reason to doubt the general correctness of Mr. Smith's explanation.

VERTICAL COMPONENTS OF ATMOSPHERIC MOTIONS.

The following passage occurs in a sentence lately examined by the Editor:

The cold, dry air, going off in all directions during a cold wave is not alone due to the temperature of the subarctic regions translated eastward and southward by the general circulation, but equally to the vertical action that is going on within the great anticyclone; a process whereby the cold of the upper air levels is brought down, proving a potent factor in augmenting the cold conditions of the lower strata.

The preceding sentence seems to imply that the cold air of the higher levels, when brought down to the earth's surface, retains its low temperature and augments the cold already prevailing in the lower strata. Does not this simple theory require careful examination? We have actual observations of the temperature of the upper air that give us something like a reliable basis for a computation on this matter. We copy from the MONTHLY WEATHER REVIEW for April, 1901, page 177, the following table, showing the mean temperatures by months, at high altitudes, on days when observations could be obtained by Leon Teisserenc de Bort, at Trappes, near Paris, by means of sounding balloons during 1898, 1899, and 1900:

TABLE 1.—*Mean temperatures.*

Month.	Paris.			Winnipeg.	
	On the ground.	At 5000 meters.	At 10,000 meters.	On the ground.	At 10,000 meters.
	° C.	° C.	° C.	° C.	° C.
January	5.4	—15.3	—47.6	—21	—74
February	1.0	—21.8	—53.4	—19	—73
March	0.9	—20.9	—53.7	—10	—65
April	5.3	—18.4	—49.3	3	—52
May	7.0	—16.8	—51.3	11	—47
June	14.2	— 8.8	—45.3	17	—42
July	15.7	— 8.7	—44.5	20	—40
August	17.8	— 7.2	—41.8	18	—42
September	13.4	— 9.7	—47.9	12	—49
October	10.2	—11.0	—45.1	4.5	—50
November	3.8	—12.8	—45.2	— 6.5	—55
December	0.9	—18.9	—52.4	—16	—69

It will be seen from this table for the latitude of Paris (which is about 48° 15′ north, and corresponds with the latitude of Manitoba), that on these special days the air at 10,000 meters altitude has, for instance, in March, an average temperature of —53.7° C., but of 0.9° at sea level. Now, the charts of mean monthly isotherms for North America give —10° C. for sea level at Winnipeg, in Manitoba, at about the same latitude and other temperatures as shown in the 5th column of Table 1. But these latter figures represent the average of the whole month and not of any special days, such as those on which balloon ascensions can be made; doubtless the averages for balloon work at Winnipeg would be higher than these, because the coldest weather is unfavorable for such work. However, the Paris observations give us a basis for estimating the rate of decrease of temperature with altitude, thus, in March, the temperature at 10,000 meters is 52.8° C. below that at the ground. If we apply the similar differences month by month to Winnipeg we get some idea as to what the average temperature may be at 10,000 meters above Manitoba, and the result is given in the last column of Table 1.

Now, the above explanation of the origin of the cold air in a cold wave says that it is brought down to the earth's surface. Our first objection to this explanation is that in our American cold waves of the winter time, and in our cool waves of summer, we never experience any such low temperatures as, according to Table 1, must be prevailing above Manitoba all the year round. Neither does Paris experience the cold that is observed in the air a few miles above it. Consequently, if the cold upper air is brought down to the lower strata, and we think very likely that it is, then it must be greatly warmed up on the way down.

Our second objection to the explanation is that, according to a well established law, descending air must be compressed because it comes under greater barometric pressure, and must, therefore, be warmed, just as it is cooled by expansion when it comes under lower pressure. This is a matter of every day experience and knowledge. When air is brought down to the ground at sea level from an altitude of 10,000 meters, it must be warmed up by about 100 °C. as the direct effect of the compression. Consequently the air over Manitoba should, when it reaches the earth's surface, have a temperature of 35° C. in March, and similar high temperatures for the other months. But these extremely high temperatures do not occur in Manitoba any more than do the above-mentioned extremely low ones, and it is fair to conclude that if the atmosphere is ascending or descending, then some other law must be in operation, greatly modifying these figures. We can scarcely doubt but that the lower half of the atmosphere has some vertical as well as horizontal component in its circulation; that is to say, it is generally ascending or descending. Why then does it not arrive at the surface with the high temperatures that result from adding 100° C. to those in the 4th or 6th columns of Table 1.

One explanation is to be found in the loss of heat by radiation from the particles of air themselves, as we have attempted to explain more fully in the American Journal of Science, 1892, 3d series, vol. 43, p. 364; atmospheric Radiation and its Importance in Meteorology. (See also Met. Zeit., July, 1892, vol. 9, p. 259.) According to this, the particles of air are cooling by radiation more than they are being warmed up by the absorption of solar heat. During the long nights of autumn and winter they are of course not being warmed at all. During the short daytimes the warmth that they absorb from the sun's rays does not counterbalance the loss by radiation. But in general this absorption added to the heating produced by compression is greater than the cooling due to radiation, and, therefore, the intensely cold air of the upper layer is warmed as it descends. When its descent takes place on a gentle slope and occupies several days, then the temperature at which it reaches sea level will depend principally upon the radiation and absorption that takes place during this long interval of time. The cooling by radiation may be supposed to take place uniformly at the rate of 0.138° C. per hour, or 3.32° C. per day, if we adopt Maurer's coefficient of radiation. The absorption of solar heat partly compensates this, and gives us 2.88° C. per day as the rate of cooling. This rate of cooling would be entirely compensated by the heat produced by compression if the air descends at the rate of 288 meters per day. These figures are only approximations to what goes on in nature, but illustrate a general principle. When the upper air descends to the ground, it not only becomes relatively dry and brings with it clear sky, as was first demonstrated by Espy, but is also accompanied by a process of heating by compression, cooling by radiation, and warming by absorption, the outcome of which may be either a hot descending wind or a cold descending wind, depending wholly on the rate of descent and on the dust and moisture in the air, which control the radiation and absorption.

It is very desirable that we should have both demonstrations and measurements of the rate of ascent and descent of currents of air. In the Editor's Treatise on Meteorological Apparatus and Methods, some anemometric arrangements are mentioned by which the inclination of the winds to the horizon are supposed to be measured, but these are, in general, very unsatisfactory.

Perhaps the most convincing demonstration of the gentle slope of ascending currents is to be found by watching the slowly circling descent of buzzards and birds of prey, tracing for a hundred miles some little streak of foul air that proceeds from the carrion on the ground far away to the high altitudes at which these birds were soaring. The general slope of such a rising current is often as small as 1°.

The observations of the clouds with the nephoscope generally assume that we are observing the strictly horizontal component of motion. But the vertical component is also revealed by a proper discussion of the observations, and a general slope of 5° over the whole cloud layer visible at any station has sometimes been demonstrated by observations with the perspective nephoscope described in the above-mentioned Treatise on Apparatus and Methods. By another independent method, Mr. Louis Besson, of the Observatory of Montsouris, has lately been able to show that ascending and descending inclinations as large as 14° have been demonstrated in the clouds over Paris for the cirrus, alto-cumulus, and fracto-cumulus clouds. An excellent account of Besson's method is given in the Meteorologische Zeitschrift for September, 1903.

Any contribution to the subject of the vertical component of atmospheric motions will be welcome to the meteorologist.

PROPORTION OF RAINFALL AVAILABLE FOR PLANT USE.

A recent letter from Mr. Thede P. Blake, of Lamar, Nebr., asks:

> What proportion of our rainfall, in Chase County, Nebr., is absorbed by the dry sandy subsoil, and thus taken below the reach of plant roots?

In reply to this letter the Chief of the Bureau of Soils, Prof. Milton Whitney, states:

> We have no data regarding the character of the soil and subsoil of Chase County, Nebr., and consequently it is not possible to give any very definite answer to Mr. Blake's inquiry. In general a rainfall not exceeding 1 inch would probably be held in the upper 18 inches of a loam or clay soil sufficiently long to make the greater part of it available to the plant. This statement is made on the assumption that the soil was rather dry before the rain. A rainfall of 1 inch would increase the moisture content of the upper 18 inches of soil 7 per cent, and such a variation is not abnormal in a clay loam. If the rainfall is sufficient to saturate the soil, a considerable portion would pass into the subsoil and beyond the reach of the roots, although a part of this would be recovered through capillary action.

STATIONARY AND WHIRLED PSYCHROMETERS.

In 1886 the Weather Bureau introduced the use of the whirled psychrometer and the thin muslin covering to the wet bulb, in place of the stationary wet bulb and the thick wicking that had been used for covering. It is generally understood that the whirled psychrometer and the stationary wet bulb agree well enough when the wind velocity is 10 miles per hour or more, but may differ considerably for gentler winds and calms. There is also a decided difference between the wet bulb when covered with very thin clean muslin, and when covered with comparatively thick and oftentimes dirty cotton wicking. In fact the theory of the psychrometer assumes merely the existence of a thin film of water, and the use of a thick wicking necessitates the introduction of a new term in the formula.

It is desirable to investigate the corrections necessary in order to reduce the earlier Weather Bureau observations to the modern standard of the whirled or ventilated psychrometer. Especially is this necessary before we can reduce to the